

**REMARKS**

Claims 1-38 are pending in this application. Claims 10-11 have been cancelled without prejudice or disclaimer to the subject matter therein. Claims 1-9 and 10-18 have been amended. Claims 19-30 have been withdrawn as directed to non-elected subject matter.

Claims 10-11 have been canceled without prejudice or disclaimer, and claims 1-9 and 10-18 have been amended, for the sole reason of advancing prosecution. Applicant, by canceling or amending any claims herein, makes no admission as to the validity of any rejection made by the Examiner against any of these claims. Applicant reserves the right to reassert any of the claims canceled herein or the original claim scope of any claim amended herein, in a continuing application.

Claim 1 has been amended to recite "A polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains, the linear polymer chains being crosslinked together via linking groups and having the general formula  $-[R-X]_n-$ , wherein R is a hydrocarbon group and X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations." Support for amended claim 1 can be found throughout the specification and claims as originally filed. See, for example, claims 4, 10 and 11, as originally filed.

Claims 2-9 and 12-18 depend, either directly or indirectly, from claim 1. Claims 2-9 and 12-18 and have been amended to be in a form consistent with U.S. practice. For example, the elements beginning with the phrases "more preferably" and "in particular" have been deleted have been deleted without prejudice or disclaimer from claims 4, 5, 9, 13 and 14. In this regard, new claims 31-38 correspond to the subject matter deleted from claims 4, 5, 9, 13 and 14.

No new matter has been added.

In view of the remarks set forth below, further and favorable consideration is respectfully requested.

***I. At page 2 of the Official Action, claims 1-18 have been rejected under 35 USC § 112, first paragraph.***

The Examiner asserts that the specification, while being enabling for polymeric compositions based on polyethyleneimine and polyvinylamine, does not reasonably provide enablement for any other polymer.

Applicant respectfully submits that this rejection has been obviated by the amendment to claim 1. Specifically, Applicant submits that claim 1 has amended to recite a "polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains...." Accordingly, Applicant respectfully requests reconsideration and withdrawal of this rejection.

**II. At page 5 of the Official Action, claims 4 and have been rejected under 35 USC § 112, second paragraph.**

The Examiner asserts that claims 4 and 17 are indefinite for reciting the terms “preferably,” “more preferably” and “in particular.”

Applicant respectfully submits that this rejection has been obviated by the amendments to claims 4 and 17. Specifically, Applicant submits that claims 4 and 17 have been amended to no longer recite elements that include the terms “preferably,” “more preferably” or “in particular.” Accordingly, Applicant respectfully requests reconsideration and withdrawal of this rejection.

**III. At page 6 of the Official Action, claims 1-7 and 10-12 have been rejected under 35 USC § 102(b) as being anticipated by Hird et al. (WO 2000/55258).**

The Examiner asserts Hird et al. teach each and every element of claims 1-7 and 10-12.

Applicant respectfully traverses this rejection.

The test for anticipation is whether each and every element as set forth is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987); MPEP § 2131. The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989); MPEP §2131. The elements must also be arranged as required by the claim. *In re Bond*, 15 USPQ2d 1566 (Fed. Cir. 1990).

Amended claim 1 is directed to a polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains, the linear polymer chains being crosslinked together via linking groups and having the general formula  $-[R-X]_n-$ , wherein R is a hydrocarbon group and X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations. Claims 2-7 and 12 depend, either directly or indirectly, from claim 1. Claims 10 and 11 have been cancelled without prejudice or disclaimer.

Applicant notes that as amended claim 1 now recites subject matter from previous claims 4, 10 and 11. Specifically, Applicant notes that claim 1 recites “linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains” and that “X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations.”

In contrast, Hird et al. et al. is directed to absorbent polymer compositions for the absorption of body fluids such as urine, menses and the like. See Hird et al. at the abstract. However, unlike the presently claimed subject matter, Hird et al. do not teach a “polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains” or that “X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations.” Therefore, Hird et al. do not teach each and every element of the

presently claimed subject matter.

In view of the forgoing, it is submitted that Hird et al. do not teach, either expressly or inherently, each and every element of the presently claimed subject matter, as required for anticipation under 35 USC § 102 (b). Accordingly, the Examiner is respectfully requested to withdraw this rejection.

**III. At page 7 of the Official Action, claims 7-9 have been rejected under 35 USC § 103(a) as being unpatentable over by Hird et al. as evidenced by Shepherd et al. (Studies of cross-linked polyethylene ion exchange resin, J. Chem. Soc., pp 89-92).**

The Examiner asserts that claims 7-9 would have been obvious over Hird et al. in view of Shepard et al. because "Hird and Shepard teach the same polymeric structure and the same nature of cross-linking agent, the resulting anion-exchange group should be identical, i.e., R-N+." See the Official Action at page 8.

In view of the following, this rejection is respectfully traversed.

To establish a *prima facie* case of obviousness, the Examiner must satisfy three requirements. First, as the U.S. Supreme Court very recently held in *KSR International Co. v. Teleflex Inc. et al.*, Slip Opinion No. 04-1350, 550 U. S. \_\_\_\_ (April 30, 2007), "a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions. ...it [may] be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at

issue. ...it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does... because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." (*KSR, supra*, slip opinion at 13-15.) Second, the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *Amgen Inc. v. Chugai Pharm. Co.*, 18 USPQ2d 1016, 1023 (Fed. Cir. 1991). Lastly, the prior art references must teach or suggest all the limitations of the claims. *In re Wilson*, 165 USPQ 494, 496 (C.C.P.A. 1970).

It is submitted that a *prima facie* case of obviousness has not been established because nothing in any of the applied references, whether taken alone or in combination, teach or suggest all of the limitations of the claims as required by *In re Wilson*.

In this regard, Applicant respectfully submits that as claims 7-9 depend, either directly or indirectly, from claim 1, claims 7-9 are novel and non-obvious for at least the same reasons as claim 1. As discussed, amended claim 1 recites a "polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains" or that "X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations."

Hird et al. is discussed above with regard to the previous rejection. As discussed, Hird et al. do not teach or suggest a “polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains” or that “X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations.”

Shepard et al. do not remedy the deficiencies of Hird et al. Shepard et al. is directed to a method of preparing a transparent ion-exchange resin. See Shepard et al. at the abstract. However, like Hird et al., Shepard et al. do not teach or suggest a “polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains” or that “X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations.” Therefore, whether taken alone, or in combination, Hird et al. and Shepard et al. do not teach or suggest every element of claims 7-9.

In view of the remarks set forth herein, it is submitted that nothing in any of the applied references, taken alone or together, renders claims 7-9 obvious within the meaning of 35 USC § 103 (a). Accordingly, the Examiner is respectfully requested to withdraw this rejection.

**IV. *At page 8 of the Official Action, claims 17 and 18 have been rejected under 35 USC § 102(b) as anticipated by, or in the alternative, under 103(a) as obvious over Hird et al.***

The Examiner asserts that the subject matter of claims 17 and 18 is inherently taught by Hird et al.

In view of the following, this rejection is respectfully traversed.

Applicant respectfully submits that as claims 17 and 18 depend, either directly or indirectly, from claim 1, claims 17 and 18 are novel and non-obvious for at least the same reasons as claim 1. As discussed, amended claim 1, recites, a “polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains” or that “X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations.”

Hird et al. is discussed above with regard to the previous rejection. As discussed, Hird et al. do not teach or suggest a “polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains” or that “X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations.”

In view of the remarks set forth herein, it is submitted that nothing in Hird et al., renders claims 17 and 18 obvious within the meaning of 35 USC § 103 (a). Accordingly, the Examiner is respectfully requested to withdraw this rejection.

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- V. At page 10 of the Official Action, claims 1-7, 10 and 12-16 have been rejected under 35 USC § 103(a) as being unpatentable over by Shimokawa (US Patent No. 4,708,821) in view of Boussouira (US 2003/0190335).**

The Examiner asserts that claims 1-7, 10 and 12-16 would have been obvious because, taken together, allegedly, every element of claims 1-7, 10 and 12-16 is taught or suggested.

In view of the following, this rejection is respectfully traversed.

To establish a *prima facie* case of obviousness, the Examiner must satisfy three requirements. First, as the U.S. Supreme Court very recently held in *KSR International Co. v. Teleflex Inc. et al.*, Slip Opinion No. 04–1350, 550 U. S. \_\_\_\_ (April 30, 2007), “a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions. ...it [may] be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. ...it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does... because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.” (*KSR, supra*, slip opinion at 13-15.) Second, the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was

made. *Amgen Inc. v. Chugai Pharm. Co.*, 18 USPQ2d 1016, 1023 (Fed. Cir. 1991). Lastly, the prior art references must teach or suggest all the limitations of the claims. *In re Wilson*, 165 USPQ 494, 496 (C.C.P.A. 1970).

It is submitted that a *prima facie* case of obviousness has not been established because nothing in any of the applied references, whether taken alone or in combination, teach or suggest all of the limitations of the claims as required by *In re Wilson*.

Claim 1 is directed to a polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and polyvinylamine chains, the linear polymer chains being crosslinked together via linking groups and having the general formula  $-[R-X]_n-$ , wherein R is a hydrocarbon group and X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations. Claims 2-7 and 12-16 depend, either directly or indirectly, from claim 1. Claims 10 has been cancelled without prejudice or disclaimer.

In contrast, Shimokawa is directed to a process for preparing an aqueous gel comprising mixing a water-soluble acetoacetylated high molecular compound, a cross-linking agent and water, thereby cross-linking said high molecular compound to form an aqueous gel. However, unlike the presently claimed subject matter, Shimokawa does not teach or suggest a polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and **polyvinylamine** chains, the linear polymer chains being crosslinked together via linking groups and having the general formula  $-[R-X]_n-$ , wherein R is a hydrocarbon group and **X is a group having at least one**

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*heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations*, as recited in present claim 1. Additionally, Applicant notes that Shimokawa only disclose branched polyethyleneimine. See, for example, Shimikawa at column 4, lines 1-21. In addition, Applicant submits that Shimokawa does not teach or suggest polyvinylamine as a possible polymeric compound. Further, Applicant submits that Shimikawa does not teach or suggest the presently claimed compound, wherein X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations. Therefore, Shimokawa does not teach each and every element of the presently pending claims.

Boussouira do not remedy the deficiencies of Shimokawa. Boussouira is directed to the use of a polyamino polymer to inhibit the light-induced peroxidation of lipids, particularly inhibition of the photo-peroxidation of lipids induced by nanopigments. See Boussouira at the abstract. However, like Shimokawa, Boussouira does not teach or suggest a polymeric compound, comprising: linear polymer chains selected from the group consisting of polyethyleneimine chains and **polyvinylamine** chains, the linear polymer chains being crosslinked together via linking groups and having the general formula  $-(R-X)_n-$ , wherein R is a hydrocarbon group and **X is a group having at least one heteroatom, wherein less than 30% of the heteroatoms are connected to linking groups and remaining heteroatoms are capable of undergoing further derivativizations**, as recited in claim 1.

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Accordingly, whether taken alone, or in combination, Shimokawa and Boussouira do not teach or suggest every element of the presently pending subject matter.

In further support of the patentability of the presently claimed subject matter over the cited references, Applicant respectfully submits that with respect to the present subject matter, Applicant has found out that a polymeric compound according to the newly presented claims herein, may serve as a versatile polymeric resin with a significantly improved atom economy in comparison to prior art polymeric resins. This is due to several factors.

First, the presently claimed resin is composed of linear polymer chains, which are crosslinked together via linking groups. The linear nature of the presently claimed resin allows for controlling the degree of crosslinking. Additionally, Applicant submits that due to the linear nature of the resin a high loadability may be achieved because the linking groups that are not used for cross-linking are still reactive and may be chemically derivatized, leading to a significant increase in the atom economy.

Next, according to the present amended claims more than seventy percent of the heteroatoms are available for further derivatizations, contributing to a further significant increase in loadability and synthetic availability of the presently claimed resin. As a result, the presently claimed resin may have a loading with amino functionalities ranging between 10 and 25 mmol/g. In this regard, Applicant was able to show the aforementioned advantageous properties of the presently claimed resin. As evidence of the advantages of the present resin where polyethylenimine is utilized as a base material, Applicant

respectfully directs the Examiner's attention to paragraphs [0034] to [0036] of the presently published application, i.e., US 2006/0052532.

Applicant notes that starting from 3.4 mg of the initial resin 4, i.e., figure 2, 42 mg of a resin bearing a completely protected tridecapeptide could be synthesized. See paragraph [0050] of the presently published application. Applicant respectfully submits that this shows the significant optimized atom economy of the presently claimed resin in comparison to conventional resins.

As further evidence showing that a resin prepared with polyvinylamine as a base material according to the presently claimed subject matter would be suitable to act as a solid-phase with a high loadability having the advantage of an improved atom economy, Applicant submits Attachment A herewith. Applicant respectfully submits that Attachment A describes polymeric compounds according to the present claims.

In this regard, Applicant respectfully draws the Examiner's attention to the data under the heading "Experimental part" in Attachment A. Applicant respectfully submits that the experiments and data shown in Attachment A show that working examples utilizing the presently claimed subject matter, and specifically a resin according to the present claims which is based on polyvinylamine, exist. In this regard, Applicant respectfully submits that a polymeric resin according to the present claims has advantages over previous resins and is therefore, not obvious in view of the references cited by the Examiner

In view of the remarks set forth herein, it is submitted that nothing in any of the applied references, taken alone or together, renders claims 75-88 obvious within the meaning of 35 USC § 103 (a). Accordingly, the Examiner is respectfully requested to

withdraw this rejection.

**VI. *Newly Added Claims 31-38***

Applicant respectfully submits that claims 31-38 are novel and non-obvious for at least the reason that claims 31-38 depend from allowable claim 1. Therefore, Applicants respectfully submit that claims 31-38 are patentable.

**CONCLUSION**

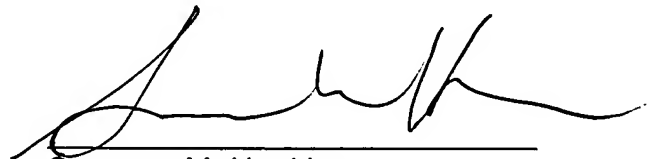
Applicant asserts that the claims are in condition for immediate allowance and early notice to that effect is earnestly solicited. Should the Examiner deem that any further action by Applicant's undersigned representative is desirable and/or necessary, the Examiner is invited to telephone the undersigned at the number set forth below.

In the event this paper is not timely filed, Applicant petitions for an appropriate extension of time. Please charge any fee deficiency or credit any overpayment to Deposit Account No. 14-0112.

Respectfully submitted,

**THE NATH LAW GROUP**

Date: November 10, 2008  
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A handwritten signature in black ink, appearing to read 'Susanne M. Hopkins', written over a horizontal line.

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# ATTACHMENT A

## **High loaded Cross-linked Polyvinylamine microbeads as a novel supporting material towards Solid-Phase synthesis and polymeric reagents**

Polymer-assisted solution-phase (PASP) synthesis plays a vital rule in the development of new chemical libraries and synthesis strategies. As the desire for high-throughput synthesis and combinatorial production of compound collections with diversity oriented structural complexity increases, the need for novel polymer-supported reagents with divers' applications and higher efficiency grows as well. Polymeric reagents can be used in highly excess with ease of purification by filtration which allows the integration of this methodology in automation and continuous flow systems. As well, polymer supports are also employed in solid-phase synthesis (SPS) where products are anchored on cleavable linker moiety.

Since reactions on solid phase are directly influenced by the synergetic interactions of polymer-solvent-reagent, the nature of polymer and its physio-chemical properties play a vital rule in their kinetics. Therefore, developing new support materials towards SPS based on new polymers is extremely important. Swelling properties, hydrophobicity, mechanical stability, chemical resistance and ease of synthesis (cost) are an important element stimulates the necessity of new supports. Traditional supports based mainly on polystyrene are suffering from several drawbacks such as stability, mobility, adsorption properties and loading capacity.

In this context, polyvinylamine (PVAm) arise as an attractive candidate for investigation. PVAm is one of the simplest synthetic amine-containing polymers, it only received significant attention in the 1990's due to the lack of efficient synthetic methods. With the advent of industrial production of N-vinylformamide, and the development of methods of poly(N-vinylformamide) (PNVF) synthesis and its subsequent hydrolysis to PVAm, derivatives of PVAm are becoming more widely available. The major applications are dry and wet strength for paper manufacturing conducted by BASF. Investigators try to explore other areas of application in water treatment, cosmetics, superabsorbent,

adhesives, and petroleum recovery. The linear, cationic, and high molecular weight polymer (PVAm) has attention corresponding to our interest in material development for chemical and biological applications. Under the name of Lubamin, BASF is the only commercially producer of PVAm as an aqueous solution.

In this work, we commence to further application of the polymer in two areas; solid phase synthesis and polymeric reagent. Micro-beads of the polymer have been prepared and functionalized for the purpose of solid phase synthesis as well as polymeric reagents. To screen the feasibility of utilizing this polymer, selected peptides have been prepared and characterized as well as examples of oxidation of alcohols to their aldehyde or ketone analogues.

## Result and discussion

As a continuity of our effort for producing polycataionic polymer with moderate swelling properties without affection polymer loading, polyvinyl amine with different cross-linking ratio were synthesized. The relatively high molecular weight polymer ( $M_{ave} = 340\ 000$ ), were cross-linked with two different ratios of terephthalaldehyde (scheme 1). Polymer A has a cross-linking ratio of 20 % based on the available primary amines in the polymer chain, while polymer B has only 10%. Efforts to synthesize polymer with lower cross-linking ratio were not successful which might be due to lower mechanical stability and high polymer solubility.

There are two mechanism for cross-linking, inter and intra network formation. In the first case amorphous polymer expected to be produced. In order to enhance regular shape formation *i.e.* beading, low concentrations of the polymer were prepared during condensation reaction (scheme 2). Under mechanical stirring, reverse phase emulsion polymerization were performed for bead formation. The density of binary solvents, dichloromethane and heptane were adjusted to match the density of polymer solution. To ensure micelles stability, 10 % solution of tween 20 were used as a surfactant. Condensation reaction can be easily notice directly after the addition of dialdehyde. A

relatively thick solution was formed in both cases of cross-linking with direct formation of regular beads. On the other hand, the reversibility of imine bond in aqueous medium arises as a challenge for synthesis. Therefore, mixing the relatively stable sodium cyanoborohydride in water, with polymer aqueous solution in early stages of the reaction will convert the imine to saturated amine. This reductive amination will shift the reaction towards more cross-linking formation. Extended mixing time up to 6 h was notice to be important to maintain the shape of beads. Immature beads tend to irreversibly agglomerate and coagulate as soon as stirring stopped or during work up. This might be explained to the incomplete reduction of imine bonds. We did not notice any major difference between bead size in both cases, although the percentage of regular beads in case of polymer A were more (scheme 3) which might reflect enhanced mechanical stability due to higher cross-linking.

Both polymers show almost similar limited swelling properties in different solvent systems (Table 1).

For the purpose of testing polymers in SPS, rink amide linker were attached to both polymers. A loading capacity of 1.5 mmol/g and 4.7 mmol/g was determined for polymer A and Polymer B respectively.

Four peptide sequences were tested and analyzed by LC-MS ....

1. Swelling Properties: Polymer A and B were tested in different solvents. Polymer A showed better swelling properties than Polymer B. Polymer B was not tested in methanol and acetonitrile.

2. Oxidation of the linker: Polymer A and B were tested in different solvents. Polymer A showed better oxidation properties than Polymer B. Polymer B was not tested in methanol and acetonitrile.

## Experimental part

**Reagents and General Methods.** PVAm was a gift from BASF (Mannheim, Germany). as a solution with 5.8 % polymer, and 126 mmol amine/100g solution ( $M_{av} = 340\ 000$ ),

Sodium cyanoborohydride, terephthalaldehyde, fmoc-amino acids, rink amide linker, iodomethane, and all other reagents were purchased from commercial suppliers. Fmoc solid-phase peptide synthesis was conducted in plastic syringes equipped with PE filters. Loading was determined by photometric methods after Fmoc cleavage. Solid phase reactions were monitored through FT-ATR-IR spectra of the resins with a Bruker Vector 22/Harrick SplitPea ATR unit. Cleaved products were analysed by an analytical HPLC column (5  $\mu$ m, 250 x 2 mm, Nucleosil 100 RP-C18) with detection at 220 nm and 254 nm. Eluents A (0.1 % TFA in water) and B (0.1 % TFA in acetonitrile) were used in a linear gradient (5 % B 95 % B in 15 min). LC-MS were recorded on an Agilent 1100 series chromatography workstation (Agilent Technologies) equipped with a single quadrupole mass spectrometer and electrospray ionization (ES). <sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded on a Bruker AVANCE 300 MHz, or 600 MHz instruments and chemical shifts ( $\delta$ ) were measured in parts per million (ppm).

#### **Preparation of 20 % cross-linked polyvinylamine (1).**

To a 100 g of polymer solution placed in 1 L round bottom, Sodium cyanoborohydride (2.33 g, 37 mmol) was added. To the solution 260 mL, 300 mL, and 3mL of dichloromethane, heptane, and tween 20 10% was added respectively. The reaction mixture was stirred mechanically at a speed of 1200 rpm at room temperature for 10 min. to the reaction mixture, terephthalaldehyde (3.38 g, 25 mmol) dissolved in 20 mL dichloromethane (DCM) was added rapidly . The reaction mixture was stirred further for 6 h then washed with 5 bed volume water and tetrahydrofuran (THF) respectively. The polymer beads were swollen in 1 M NaOH solution for 15 min. followed by washing again with 5 bed volume water, THF, DCM, and methanol respectively. After drying in vacuo for 12 h at room temp., 9 g (> 95 %) of a pal yellow polymer were obtained. IR EA

#### **Preparation of 20 % cross-linked polyvinylamine functionalized with rink amide linker (2).**

To a solution of rink amide resin (1.6 g, 3mmol) in 5 mL *N,N*-Dimethylformamide, *O*-(Benzotriazol-1-yl)-*N,N,N',N'*-tetramethyluronium tetrafluoroborate (TBTU) (0.96 g, 3 mmol), *N*-ethyldiisopropylamine (DIPEA), (500  $\mu$ L, 6mmol) were added respectively. The reaction mixture were stirred for 10 min then added to 1.0 g of polymer 1 swollen in 2.5 mL DMF. After 3 h stirring the reaction were filtered and washed with DMF then the coupling were repeated in the same way for another 3 h. The polymer were washed 5 times with 10 mL DMF followed by acylation with 10 mL 10 % Acetic anhydride/DMF soln for 3 h. After washing with 10 mL DMF, THF, DCM, and MeOH respectively, polymer were dried in vacuo at room temp. for 12 h to produce 1.8 g polymer 2. Loading is 1.5 mmol/g resin. IR:EA

#### **Preparation of 20 % cross-linked polyvinylamine, quaternary salt (3).**

Resin 1 (1 g) was swollen in DMF (5 mL) and methy iodide (16 g, 116 mmol) were added. After shaking for 24 h at room temperature, the quaternized polymer was washed with 10 mL DMF and DCM respectively and dried in vacuo for 12 h at room temperature to yield polymer 3 (1.28 g) as a yellow beads. EA FT-ATR-IR:

#### **Preparation of 20 % cross-linked polyvinylamine, perruthenate salt (4).**

To the quaternized polymer 3 (0.25 g) after swollen in water, potassium perruthenate (1g) dissolved in 2.5 mL water was added. After shaking for 24 h the resulting polymer was washed with water, THF, hexane, and MeOH. By repeating this procedure for two times resin were dried in vacuo for 12 h at room temperature producing a black polymer (0.497 g) with loading of 3mmol/g EA FT-ATR-IR

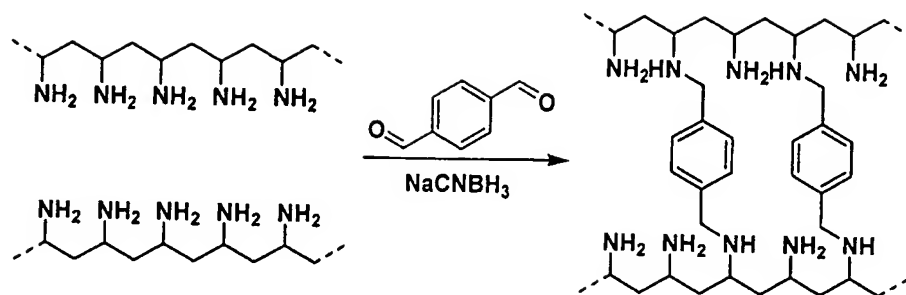
#### **General procedure for solid phase peptide synthesis SPPS**

Fmoc-amino acid (1mmol) were activated with *N,N'*-diisopropylcarbodiimide (DIC) (1 mmol) and 1-Hydroxybenzotriazole (1 mmol.) in 3 mL DMF for 10 min. In a 10 mL plastic syringe 0.2 g of polymer 2 previously swollen in DMF were treated with 20 % piperidine/DMF in order to remove FMOC-protecting group. The reaction mixture were poured on the de-protected resin and was shaking for 3 h. The same procedure was repeated twice for each coupling. Finally the peptide sequence was acylated by treating

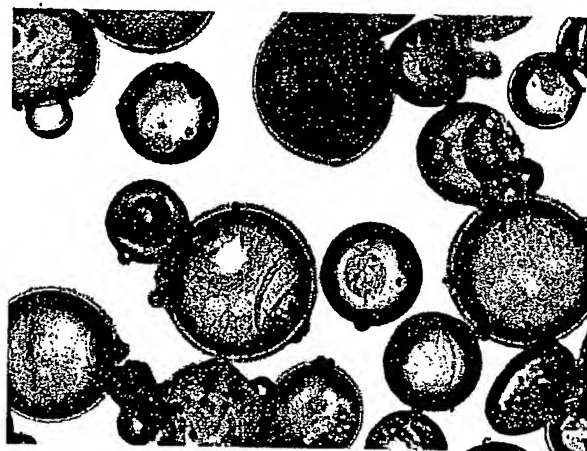
resin with 10 % acetic anhydride for 3 h twice. After washing, polymer was treated with 95 % trifluoroacetic acid (2 mL) for three hours. After removing solvents under vacuo, peptide were analyzed with LC-MS and NMR.

#### **General procedure for oxidation of alcohols**

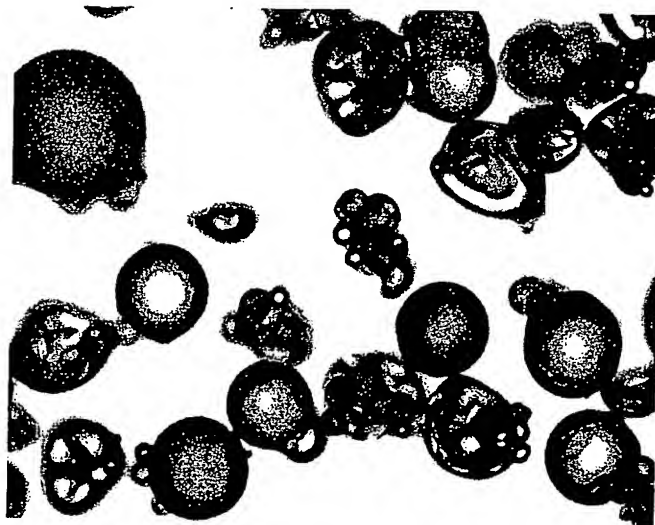
To polymer **4** (30 mg) in THF (1 mL), (0.1 mmol) of alcohol and 4-Methylmorpholine *N*-oxide (NMO) was added respectively. The reaction mixture was gently stirred at 75 °C for 3 h. The completion of reaction were indicated by thin layer chromatography. The completion of the reaction was indicated by TLC. The resin was filtered off and washed for three times with THF, DCM (10 mL). Solvents was removed and products were analyzed by LC-MS and NMR.



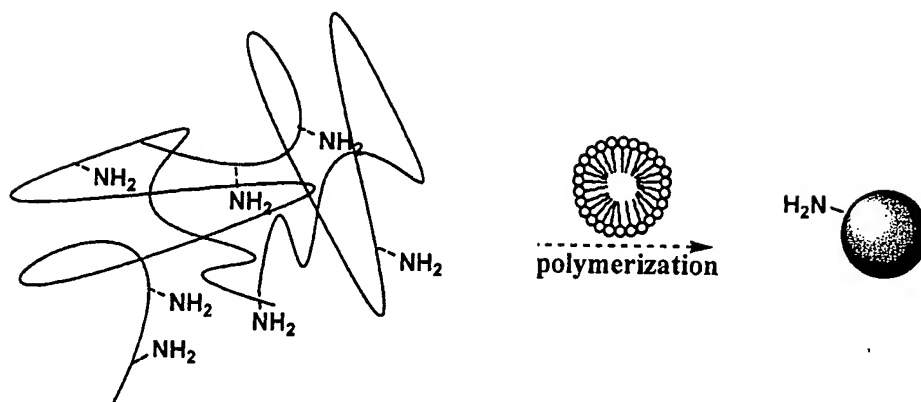
Scheme 1. Synthesis of resin 1 by cross-linking with terephthalaldehyde in different ratios



Scheme 3 a: microscopic picture represent beads within a range from 100 to 200  $\mu\text{m}$  formed upon polymer A.



Scheme 3 b: microscopic picture represent beads within a range from 100 to 200  $\mu\text{m}$  formed upon polymer B.



Scheme 2. Reversed phase emulsion polymerization at high dilution enhances beads formation.